AMENDMENTS TO THE SPECIFICATION

Please amend paragraph [0001] beginning at page 1, line 9, as follows:

[0001] The present application claims [[a]] priority under 35 U.S.C. § 119 to Japanese Patent Application No. 2002379231 filed on December 27, 2002, entitled "Capacitor and method for producing the same, and circuit board with a built-in capacitor and method for producing the same." The contents of that application are incorporated herein by the reference thereto in their entirety.

Please amend paragraph [0003] beginning at page 1, line 24, as follows:

[0003] Recently, as ~~an~~ electric and electronic devices have ~~device~~ become smaller ~~more miniature~~ and more dense, ~~high-density, there are employed~~ many techniques have been employed wherein a circuit board having a plurality of components is modularized as a package for each functional block, and the necessary modules are combined so as to obtain a predetermined electrical circuit, as a substitute for a prior technique wherein individual components are mounted on a board so as to form an electrical circuit. This module is generally formed by mounting necessary components on one or both surfaces of a daughter board. However, when a technique which includes mounting components on a surface of a board is employed, a surface area of the module cannot be smaller than those of the mounted components (that is, the total foot prints of the components). For this reason, there is a limitation to high-density assembly, even when this technique is employed. Further, since the components are disposed on a flat surface according to the technique, a connection distance between the components is inevitably longer depending on its constitution, which results in a problem of an increase in loss and an increase in inductance at a high frequency.

Please amend paragraph [0005] beginning at page 3, line 16, as follows:

[0005] A capacitor is included in main components for constituting the functional module. Recently, as ~~an~~ electronic equipment has become ~~is~~ increasingly digitalized and operates

at [[a]] higher ~~speed~~ speeds, it is strongly required that the capacitor used therefor has a large capacitance and a low impedance.

Please amend paragraph [0009] beginning at page 5, line 19, as follows:

[0009] In a case where the capacitor is embedded in the substrate, as the capacitor is smaller in size, an advantage in terms of configuration such as miniaturization and higher-density of the module and an electrical advantage such as a shortened wiring length and a low impedance are obtained more effectively. However, the capacitor of the above-described configuration tends to be larger in size, since the molding resin and lead frames are disposed around the capacitor element. For this reason, such a capacitor package does not offer these advantages sufficiently. Therefore, an attempt to connect the capacitor element three-dimensionally to the board has been made by embedding the capacitor element directly in the board without using the molding resin and the lead frames.

Please amend paragraph [0010] beginning at page 6, line 8, as follows:

[0010] When the capacitor is mounted on a wiring layer of a predetermined wiring pattern with solder, solder mounting which is conventionally employed for mounting a chip component cannot be employed since the valve metal element for an anode is not wetted by the solder. Further, use of lead (Pb) is restricting from the viewpoint of environmental protection, and therefore, Sn-Pb eutectic solder which has been conventionally used is nearing ~~toward~~ prohibition. As an alternative to this, a solder material which does not contain Pb is developing. The melting point of the Pb-free material is generally higher than that of the eutectic solder. As the melting point of the solder material is higher, the capacitor element is more seriously damaged by heat that is applied upon welding, which results in deterioration of the capacitor properties. In order to avoid such a disadvantage, a method for connecting the capacitor to the wiring pattern with a Pb-free electrically conductive adhesive is also employed.

Please amend paragraph [0011] beginning at page 7, line 1, as follows:

[0011] However, when the anode of the capacitor and the wiring pattern are connected with the electrically conductive adhesive (herein referred to as a conductive adhesive), there is a problem of an increase in connection resistance at the anode due to the dielectric oxide film on the surface of the anode valve metal element, which makes it difficult to realize the low ESR. Further, since the surface of the valve metal element is roughened, the conductive adhesive is absorbed into pores (that is, depressed portions) of the anode formed by the surface roughening treatment. This also presents a problem of an increase in connection resistance. Further, this presents a problem of deterioration of the connection reliability because of a low bonding strength between the anode and the conductive adhesive.

Please amend paragraph [0012] beginning at page 7, line 18, as follows:

[0012] In order to solve these problems, the present invention provides an electrolytic capacitor in the form of an element with a low ESR and a low height which can be connected to a wiring layer with a low resistance and is suitable for being embedded in a circuit board, and a method for producing the same. Further, the present invention provides a module with a built-in capacitor of a small size, a low height and a high density which has a low ESL and high-frequency responsibility and can be driven by a large current, and a method for producing the same. Furthermore, the present invention provides a module with a built-in capacitor which has an electrical function as a single package.

Please amend paragraph [0014] beginning at page 8, line 19, as follows:

[0014] The capacitor of the present invention is characterized in that at least one through hole is formed in the electrode lead part of the valve metal element for an anode so that the core of the valve metal element is exposed to the outside. Here, the "core" of the valve metal element means a metal part of the valve metal element. In the electrolytic capacitor of the present invention, the core of the valve metal element is exposed to the outside on at least a part of the inner surface of the through hole. A portion where the core is exposed to the outside corresponds to a metal surface which is not oxidized or a surface of a thin oxide film which is formed by

natural oxidation. Therefore, the interface resistance of a connection area between the portion where the core is exposed to the outside and an electric conductor (such as a conductive adhesive) is much smaller than that of a connection area between the dielectric oxide film and the electric conductor. For this reason, in the present invention, the portion where the core is exposed to the outside (hereinafter, referred to as a "core-exposed portion") serves as a connection portion (or a connection terminal) of the anode. Therefore, the present invention can provide an electrolytic capacitor with high connection reliability, in which a low connection resistance at the anode and a low ESR are low.

Please amend paragraph [0015] beginning at page 9, line 18, as follows:

[0015] In the capacitor of the present invention, the through hole is filled with an electrically conductive resin composition (herein referred to as conductive resin composition) containing metal powder and a thermosetting resin, which composition is connected to the core of the valve metal element. The connection between the conductive resin composition and the core of the valve metal element is made by curing ~~cure of~~ the thermosetting resin. In the capacitor of this constitution, the core-exposed portion is covered with and electrically connected to the conductive resin composition. Therefore, in this capacitor, the core-exposed portion of the valve metal element serves as the connection portion through the conductive resin composition. Further, the conductive resin composition makes it possible to easily and reliably provide an electrical connection between the core of the valve metal element and an other member (for example, a wiring layer of a circuit board). This is because the connection does not require the conductive adhesive to be inserted into the through hole to contact with the inner surface of the hole. Therefore, the capacitor of this constitution has a lower ESR and more improved reliability.

Please amend paragraph [0017] beginning at page 10, line 23, as follows:

[0017] Alternatively, the electrolytic capacitor of the present invention preferably includes a single electrically conductive particle (herein referred to as conductive particle) or a single electrically conductive fiber (herein referred to as conductive fiber) which contacts with at

least a part of the core portion of the valve metal element in the through hole. The conductive particle and the core-exposed portion are electrically connected at the contact area therebetween. Therefore, in this capacitor of this constitution, the core-exposed portion of the valve metal element serves as the connection portion through the conductive particle or the conductive fiber which exists in the through hole. The capacitor of this constitution is also easily connected to the other member with the conductive adhesive since the conductive particle or the conductive fiber exists within the through hole. Therefore, this capacitor also has a lower ESR and more improved reliability.

Please amend paragraph [0018] beginning at page 11, line 16, as follows:

[0018] It is preferable that the end portion(s) of the conductive particle or the conductive fiber disposed within the through hole extends slightly beyond a surface(s) of the electrode lead part which surface is to be connected to the other member (such as a wiring board), which facilitates connecting the capacitor to, for example, a wiring layer.

Please amend paragraph [0020] beginning at page 12, line 6, as follows:

[0020] In the capacitor of the present invention having the through hole, it is preferable that at least one electrically conductive particle contacts with the core of the valve metal element for an anode in the electrode lead part. Here, "an electrically conductive particle contacts with the core of the valve metal element for an anode" means that a part of the electrically conductive particle(s) pierces the dielectric oxide film formed on the surface of the valve metal element for an anode and reaches the core. The core which contacts with the conductive particle(s) can be electrically connected to the other member (such as a wiring board) through the particle. That is, this conductive particle(s) as well as the core-exposed portion can serve as the connection portion of the anode. Therefore, this constitution increases the area of the connection portion of the anode resulting in a lower connection resistance, and therefore an electrolytic capacitor of a lower loss can be obtained.

Please amend paragraph [0021] beginning at page 12, line 24, as follows:

[0021] In the above electrolytic capacitor wherein the conductive particle(s) contacts with the core of the anode valve metal element, it is preferable that at least a part of the particle(s) is coated with a thermosetting resin. That is, it is preferable that the conductive particle(s) is fixed to the anode valve metal element with the thermosetting resin. This constitution improves a connection strength between the conductive particle(s) and the anode valve metal element, and therefore provides ~~gives~~ an electrolytic capacitor which has a higher connection stability and a higher reliability.

Please amend paragraph [0023] beginning at page 13, line 18, as follows:

[0023] Further, the present invention provides a circuit board with a built-in capacitor wherein the electrolytic capacitor of the present invention is disposed within an electrically insulating layer, and connected to a wiring layer with a conductive adhesive. "An electrolytic capacitor is disposed within an electrically insulating layer" means that a part or the whole of the electrolytic capacitor is buried or embedded in the electrically insulating layer. This circuit board with a built-in capacitor includes a small-sized electrolytic capacitor which does not have a molding resin and lead frames. Further, the anode of the electrolytic capacitor is connected to the wiring layer at the core-exposed portion of the valve metal element, and the cathode is connected to the wiring layer on a surface of the charge collecting element for a cathode, through the conductive adhesive respectively. As described above, the electrolytic capacitor enables the anode to be connected to the wiring layer with a low connection resistance. Therefore, the circuit board with a built-in capacitor of the present invention is characterized in that 1) its height is low, 2) miniaturization and higher-density of the board can be realized, and 3) it has a low ESR and a low ESL which enables high-frequency response and large-current driving of the board.

Please amend paragraph [0026] beginning at page 15, line 6, as follows:

[0026] In the circuit board with a built-in capacitor of the present invention, the electrically insulating layer within which the capacitor is disposed preferably contains an

inorganic filler and a thermosetting resin. By selecting the inorganic filler optimally, the coefficient of linear ~~liner~~ expansion, the thermal conductivity and the dielectric constant of the electrically insulating layer can be controlled, which results in a circuit board with a built-in capacitor which has a high reliability and is excellent in heat releasability and high speed responsibility. By selecting the thermosetting resin optimally, the coefficient of linear ~~liner~~ expansion, the glass transition point, and the elastic modulus of the electrically insulating layer can be controlled, which results in a circuit board with a built-in capacitor which has a high reliability.

Please amend paragraph [0033] beginning at page 19, line 15, as follows:

[0033] This configuration gives a circuit board with a built-in capacitor that serves as a miniature and thin functional module of high density which fulfills a function of an electrical circuit as a single package. Further, this configuration wherein an element for forming an electrical circuit is disposed within the board, provides ~~gives~~ a more miniature and thinner circuit module. Furthermore, this configuration makes it possible to shorten the wiring length of the entire circuit, resulting in a circuit module which has a low loss, ~~and~~ a low stray capacitance and a low inductance. In addition, the module presents improved noise immunity, since a ~~an~~ passive component can be disposed near the semiconductor chip. Therefore, the present invention makes it possible to obtain a circuit board with a built-in capacitor serving as a good functional module, in which 1) miniaturization, 2) higher-density, 3) low-height, and 4) excellent high-speed operation ~~responsibility~~ are realized.

Please amend paragraph [0036] beginning at page 21, line 23, as follows:

[0036] In this microprocessor module, the microprocessor is generally mounted on a surface of the circuit board with a built-in capacitor of the present invention. The microprocessor is preferably arranged so that the electrolytic capacitor of the present invention is placed just below the microprocessor. This arrangement makes it possible to reduce the area occupied by the

module. Further, this arrangement makes it possible to shorten the distance between the microprocessor and the capacitor, resulting in a microprocessor module excellent in high-speed operation ~~responsibility~~.

Please amend paragraph [0039] beginning at page 23, line 22, as follows:

[0039] Alternatively, the electrolytic capacitor of the present invention may be produced by a method including:

(a) forming a dielectric oxide film by oxidizing a surface of a valve metal element for an anode which includes a capacitor forming part and an electrode lead part;

(c) forming a through hole(s) in the electrode lead part of the valve metal element for an anode to expose the core of the valve metal element; and

(b) forming a solid electrolyte layer on the dielectric oxide film, followed by forming a charge collecting element for a cathode on the solid electrolyte layer, wherein ~~in this order (that is, the~~ operations (a), (c) and (b) are performed in the stated order. ~~order).~~

Please amend paragraph [0040] beginning at page 24, line 10, as follows:

[0040] Both of the above methods are characterized in that the through hole(s) is formed in the electrode lead part of the valve metal element for an anode of the electrolytic capacitor so as to expose the core of the valve metal element. The two methods are different in when the through ~~trough~~ hole(s) is formed. In the first method, the through hole(s) is formed after the solid electrolyte layer and the charge collecting element for a cathode have been formed. In the second method, the through hole(s) is formed before the solid electrolyte layer and the charge collecting element for a cathode are formed. The advantage of the first method is that the core is not oxidized even if a heat treatment is conducted for polymerizing the electrolyte layer. The advantage of the second method is that a work piece is handled easily when forming the through hole(s).

Please amend paragraph [0041] beginning at page 24, line 25, as follows:

[0041] A method for producing a solid electrolytic capacitor generally includes the operations (a) and (b). Hereinafter, in order to clarify the features of each production method of the present invention and to avoid a lengthy description, "forming a dielectric oxide film by oxidizing a surface of a valve metal element for an anode which includes a capacitor forming part and an electrode lead part" is merely referred ~~refers~~ to as "the operation (a)", and "forming a solid electrolyte layer on the dielectric oxide film, followed by forming a charge collecting element for a cathode on the solid electrolyte layer" is merely referred ~~refers~~ to as "the operation (b)."

Please amend paragraph [0046] beginning at page 27, line 6, as follows:

[0046] The above two methods are characterized in that the through hole is formed in the electrode lead part of the valve metal element while the conductive particle or fiber is disposed within ~~in~~ the hole, by having the particle or fiber pierce the electrode lead part. This production method produces ~~gives~~ an electrolytic capacitor wherein the conductive particle or fiber closely contacts with the core of the valve metal element.

Please amend paragraph [0048] beginning at page 28, line 2, as follows:

[0048] This method makes it possible to have one or more electrically conductive fibers pierce ~~pierces~~ a plurality of electrode lead parts of the valve metal elements of the electrolytic capacitor units. ~~units, at a time.~~ Therefore, according to this method, an electrolytic capacitor wherein an electrically conductive fiber is disposed within the electrode lead part of the valve element can be produced with a higher productivity.

Please amend paragraph [0049] beginning at page 28, line 10, as follows:

[0049] Any of the above-described methods for producing the electrolytic capacitor may further include bringing at least one electrically particle into contact with the core of the valve metal element for an anode, by disposing the particle on the electrode lead part of the valve metal element followed by pressurizing. In this operation, the pressurization is performed so that a part

of each conductive particle pierces the dielectric oxide film on the electrode lead part and reaches the core, and the other part is positioned above the surface of the dielectric oxide film, in other words, so that the particle is projected from that surface. That is, the pressurization is performed so that a part of each conductive particle is buried in the electrode lead part. These additional operations make it possible to produce an electrolytic capacitor wherein an electrically conductive particle(s) contacts with the core of the valve metal element for an anode at the electrode lead part in which the through hole(s) is formed.

Please amend paragraph [0050] beginning at page 29, line 3, as follows:

[0050] Alternatively, any of the above-mentioned methods for producing the electrolytic capacitor may further include: ~~includes:~~

bringing at least one electrically conductive particles into contact with the core of the valve metal element for an anode, by disposing an electrically conductive resin composition containing the particle(s) and an uncured thermosetting resin on the electrode lead part of the valve metal element and then by pressurizing; and

bonding the electrically conductive resin composition to the electrode lead part of the valve metal element for an anode by a heat treatment. The pressurization is performed in the same manner as described above, so that a part of the electrically conductive particle is buried in the electrode lead part. These operations make it possible to produce an electrolytic capacitor wherein a conductive particle(s) contacts with the core of the valve metal element in the electrode lead part in which the through hole(s) is formed, and fixed to the electrode lead part with a thermosetting resin.

Please amend paragraph [0051] beginning at page 29, line 23, as follows:

[0051] Alternatively, any of the above-described methods for producing the electrolytic capacitor may further include:

applying an electrically conductive resin composition containing metal powder and a thermosetting resin to the electrode lead part of the valve metal element for an anode; and

bonding the conductive resin composition to the electrode lead part of the valve metal element for an anode by heat treatment. These operations make ~~makes~~ it possible to produce an electrolytic capacitor wherein a layer of an electrically conductive resin composition containing metal powder and a thermosetting resin is formed on a surface of the electrode lead part wherein the through hole is formed.

Please amend paragraph [0057] beginning at page 34, line 3, as follows:

[0057] In this production method, the electrolytic capacitor is fixed to a surface of the metal foil that is to be a wiring layer, and the electrically insulating substrate is superposed thereon. That is, in this production method, the step of disposing the electrolytic capacitor within the electrically insulating layer and the step of fabricating the circuit board having the wiring layer and the electrically insulating layer are conducted at the same time. Therefore, this production method does not require preparing a first wiring board previously, and therefore, provides ~~gives~~ a more miniature and thinner circuit board with a built-in capacitor. Further, this production method makes it possible to dispose the electrolytic capacitor adjacent to an external electrode of the circuit board, resulting in a circuit board with a built-in capacitor having an improved high-frequency responsibility.

Please amend paragraph [0062] beginning at page 37, line 5, as follows:

[0062] The electrolytic capacitor of the present invention is an element which does not have a molding resin and lead frames, and characterized in that through hole(s) is formed in the electrode lead part of the valve metal element for an anode to expose the core of the valve metal. The surface of the exposed core serves as a connection portion which can be connected to the other member (particularly, a wiring board) with a low resistance. The electrolytic capacitor of the present invention provided with such a connection portion is suitable for being connected to a wiring layer of the wiring board using an electrically conductive adhesive. Further, since the electrolytic capacitor of the present invention is in the form of an element, this capacitor can

constitute a circuit board with a built-in capacitor which has a low height and a high reliability, and presents a low connection resistance.

Please amend paragraph [0063] beginning at page 37, line 21, as follows:

[0063] Further, by incorporating the electrolytic capacitor of the present invention together with other components into a circuit board, a miniature module containing built-in components at a high density is provided ~~given~~. Although the area needed for setting the module with built-in components of the present invention is small, this module fulfills many functions. Further, in this module, it is possible to shorten the wiring length and to dispose a semiconductor chip adjacent to the electrolytic capacitor, whereby the stray capacitance and the stray inductance are reduced. Therefore, the present invention provides ~~gives~~ a low-loss circuit board with a built-in component which functions as a desired circuit and has an excellent high-speed operation ~~responsibility~~.

Please amend paragraph [0064] beginning at page 38, line 12, as follows:

[0064] A more complete appreciation of the invention and many of the attendant advantages thereof will become readily apparent with reference to the following detailed description, particularly when considered in conjunction with the accompanying drawings, in which:

Fig. 1 shows a sectional view of a conventional electrolytic capacitor which corresponds to a fundamental electrolytic capacitor unit for constituting an electrolytic capacitor of the present invention;[[.]]

Figs. 2(a) and 2(b) show a sectional view and a plan view of an embodiment of an electrolytic capacitor of the present invention, respectively;

Fig. 3 shows a sectional view of another embodiment of an electrolytic capacitor of the present invention;

Fig. 4 shows a sectional view of ~~further~~ another embodiment of an electrolytic capacitor of the present invention;

Fig. 5 shows a sectional view of still ~~further~~ another embodiment of an electrolytic capacitor of the present invention;

Figs. 6(a) to 6(c) schematically show the steps for producing an electrolytic capacitor of the present invention;

Fig. 7 shows a sectional view of another embodiment of an electrolytic capacitor of the present invention;

Figs. 8(a) to 8(d) schematically show sectional views illustrating the steps in an embodiment of a method for producing a circuit board with a built-in electrolytic capacitor of the present invention;

Figs. 9(a) to 9(d) schematically show sectional views illustrating the steps in another embodiment of a method for producing a circuit board with a built-in electrolytic capacitor of the present invention;

Figs. 10(a) to 10(d) schematically show sectional views illustrating the steps in ~~further~~ another embodiment of a method for producing a circuit board with a built-in electrolytic capacitor of the present invention;

Figs. 11(a) to 11(d) schematically show the steps in a method for producing a module with built-in components of the present invention;

Fig. 12 is a graph illustrating ESR at 100 kHz of a wiring board on which an electrolytic capacitor obtained in Example 1 is mounted;

Fig. 13 is a graph illustrating ESR at 100 kHz of a circuit board wherein an electrolytic capacitor obtained in Example 1 is built-in;

Fig. 14 shows a schematic circuit diagram of the electric circuit of a switching power supply module of the present invention;

Fig. 15 shows a sectional view of an embodiment of a switching power supply module of the present invention; and

Fig. 16 shows a sectional view of an embodiment of a microprocessor module of the present invention.

Please amend paragraph [0066] beginning at page 41, line 1, as follows:

[0066] The fundamental configuration of the present invention is a solid electrolytic capacitor unit which includes a valve metal element for an anode including a capacitor forming part and an electrode lead part, a dielectric oxide film provided on a surface of the valve metal element for an anode, a solid electrolyte layer provided on the dielectric oxide film, and a charge collecting element for a cathode provided on the solid electrolyte layer. This corresponds to a conventional electrolytic capacitor. An electrolytic capacitor of the present invention is constituted by forming a through hole(s) in the electrode lead part of the valve metal element for an anode of this electrolytic capacitor unit so as to expose the core of the valve metal element to the outside.

Please amend paragraph [0072] beginning at page 43, line 4, as follows:

[0072] In the solid electrolytic capacitor shown in Fig. 1, only one electrode lead part 10B for the anode is formed. The fundamental configuration of the present invention may be a solid electrolytic capacitor which has a three-terminal configuration wherein two electrode lead parts for the anode are provided, or a four-terminal configuration wherein both of the anode and the cathode have two electrode lead parts. The embodiments described below are applicable to such capacitors.

Please amend paragraph [0073] beginning at page 43, line 15, as follows:

[0073] An embodiment of the electrolytic capacitor of the present invention is shown in Figs. 2(a) and 2(b). Fig. 2(b) is a plan view of the electrolytic capacitor shown in Fig. 2(a). In Figs. 2(a) and 2(b), numeral 10C denotes a core of the valve metal element for an anode 10, and numeral 15 denotes a through hole. The inner exposed surface of the through hole 15 except for the portion of the dielectric oxide film 11 corresponds to the core-exposed portion 10D. In Fig. 2, the reference numerals which are identical to those used in Fig. 1 denote identical members or components described with reference to Fig. 1. Therefore, as to those members or components, the detailed description is omitted.

Please amend paragraph [0075] beginning at page 44, line 8, as follows:

[0075] Firstly, the aluminum foil is subjected to electrolytic etching in an electrolytic solution which mainly contains hydrochloric acid, by applying alternating current to the AI foil. Thereby, surfaces of the aluminum foil are roughened to provide ~~give~~ the valve metal element for an anode 10 with fine concavities and convexities on the surfaces, as shown in Fig. 2(a). Next, the valve metal element for an anode 10 is subjected to anodic oxidation so that the dielectric oxide film 11 with a desired pressure resistance is formed on the surfaces. The dielectric oxide film 11 is generally formed into a thickness in the range of 1 to 20 nm. However, the thickness of the dielectric oxide film 11 is not limited to this range, and it is selected depending on the desired properties of the electrolytic capacitor. Next, a conductive polymer such as polypyrrole, polypyrrole, polythiophene, or polyaniline is formed by chemical polymerization or the combination of chemical polymerization and electrolytic polymerization, using a solution containing a dopant and a monomer. During the polymerization, the valve metal element for an anode 10 is masked except for the capacitor forming part 10A. The conductive polymer layer corresponds to the solid electrolyte layer 12.

Please amend paragraph [0076] beginning at page 45, line 6, as follows:

[0076] Next, on both surfaces of the valve metal element for an anode 10, an insulator 14 is disposed at a border between the capacitor forming part 10A on which the solid electrolyte layer 12 is formed and the electrode lead part 10B. The insulator 14 is formed by bonding a tape of an appropriate electrically insulating material (such as a polyimide film) to the valve metal element. Subsequently, a carbon paste is applied to the surfaces of the solid electrolyte layer 12, followed by being cured. Next, an Ag paste is applied on the carbon paste layer, followed by being cured by heating. The ~~These~~ carbon layer and Ag paste layer serve as the charge collecting element for a cathode 13. The carbon paste and Ag paste are applied by, for example, dipping. Alternatively, the charge collecting element for a cathode 13 may be formed by laminating a metal foil such as a Cu, Ni, or Al foil. In that case, the metal foil is bonded to the solid electrolyte layer 12 using the carbon paste.

Please amend paragraph [0078] beginning at page 46, line 7, as follows:

[0078] Next, the through hole 15 is formed in the electrode lead part 10B of the valve metal element for an anode so that the unoxidized core 10C of the valve metal element for an anode is exposed to the outside, whereby the electrolytic capacitor of the present invention having the core-exposed portion 10D as shown in Fig. 2(a) can be obtained. The through hole 15 may be formed using, for example, a NC punching machine. Alternatively, the through hole 15 may be formed by a method wherein a punching die is used, or by a YAG laser. The diameter of the through hole 15 is, for example, from 30 to 300 μm. However, the size of the through hole 15 is not limited to this range. Further, a plurality of through holes 15 are preferably formed. Fig. 2(b) shows an electrolytic capacitor wherein three through holes 15 are formed, as one example. As the number of the through holes 15 is increased, the capacitor is connected to a wiring layer with a lower connection resistance, resulting in a low-loss circuit board with a built-in capacitor and a low-loss module with a built-in components, and an improved connection reliability. However, as the number of the through holes 15 is increased, the strength of the electrode lead part 10 becomes lower. Therefore, it is necessary to select the number of the through holes 15 so that the electrolytic capacitor is not broken by a force which is applied upon producing the circuit board with a built-in capacitor. Generally, the number of the through holes 15 is preferably in the range of 1 to 8 per 1 mm^2.

Please amend paragraph [0082] beginning at page 48, line 15, as follows:

[0082] Metal powder and a thermosetting resin are mixed to give an electrically conductive resin composition. The metal powder is preferably made of a metal that is excellent in conductivity and stability. For example, a metal or an alloy powder of which the major component is Ag, Cu, Au, Ni, Co or Pd may be preferably used. Particularly, Ag or Cu powder, or powder made by an alloy containing Ag or Cu may be preferably used. The diameter of the metal powder is preferably in the range of 0.1 to 100 μm. The thermosetting resin in an uncured state is mixed with the metal powder. For example, an epoxy resin, a phenol resin or a polyimide resin can be used as the thermosetting resin. These resins are ~~resin is~~ preferably used because of

high reliability. The uncured thermosetting resin is preferably mixed in an amount of 30 to 150 parts by volume with the 100 parts by volume of the metal powder. Further, the conductive resin composition may further contain a curing agent, a curing catalyst, a surface active agent and/or a coupling agent.

Please amend paragraph [0086] beginning at page 50, line 13, as follows:

[0086] The cross-sectional shape of the through hole 15 is not limited to a circle, and may be any of a square, a rectangular, and an oval. When the cross-sectional shape of the through hole 15 is not a circle, the preferable size of the through hole is defined by a minimum value and a maximum value of the diametrical distance between two arbitrary points on the outline of the cross-section of the through hole. Specifically, the minimum value is preferably longer than 0.5 times the thickness of the valve metal element for an anode, and the maximum value is preferably ~~is~~ less than 2 times the thickness of the valve metal element for an anode. Further, also in this embodiment, a plurality of through holes 15 may be formed and filled with the conductive resin composition.

Please amend paragraph [0092] beginning at page 53, line 3, as follows:

[0092] As the conductive particle 17, a particle of a high conductivity is used which has a hardness that enables the particle to pierce the valve metal element for an anode 10 without the break of the particle upon pressurization. Specifically, a particle made of a metal or an alloy of which the main component is selected from Ag, Cu, Ni, Pd, Pt and Au, may be used. The conductive particle 17 has a diameter which is larger than the thickness of the valve metal element for an anode 10, and preferably has a diameter which is 1.0 to 1.2 times the thickness of the valve metal element for an anode 10, and more preferably has a diameter which is 1.05 to 1.2 times the thickness of the valve metal element for an anode 10. In the case where the conductive particle of such a diameter is disposed within the valve metal element for an anode, the upper and the lower end portions of the particle are projected from the surfaces of the capacitor, whereby the capacitor is advantageously connected to an other member (such as a wiring board). A

pressurization method is not limited to a particular one. For example, a pressing can be employed for piercing the valve metal element for an anode with the conductive particle 17.

Please amend paragraph [0099] beginning at page 55, line 22, as follows:

[0099] The conductive fiber 18 is made of a metal material which has a high conductivity and can be worked into a fiber or a thin wire. Specifically, as the conductive fiber 18, a fiber or a thin wire which is obtained by working a metal or an alloy of which the main component is selected from the group consisting of Ag, Cu, Ni, Pd, Pt, Au and Al, can be used. The conductive fiber 18 has a length larger than the thickness of the valve metal element for an anode 10, and preferably has a length which is 1.0 to 1.2 times the thickness of the valve metal element for an anode 10, and more preferably has a length which is 1.05 to 1.2 times the thickness of the valve metal element for an anode 10. In the case where the conductive fiber of such a length is disposed within the valve metal element for an anode, the upper and the lower end portions of the fiber are projected from the surfaces of the capacitor, whereby the capacitor is advantageously connected to an other member (such as a wiring board). The diameter of the conductive fiber 18 is preferably in the range of 20 to 200 μm. A method for making the conductive fiber 18 pierce the valve metal element is not limited to a particular one. The conductive fiber 18 can pierce the valve metal element for an anode by being pressurized by means of, for example, a pressing machine, a wire bonder or an ultrasonic.

Please amend paragraph [0111] beginning at page 61, line 2, as follows:

[0111] The conductive particles 19 are prepared and disposed on the electrode lead part 10B of the valve metal element for an anode 10 followed by being pressurized. Thereby, the conductive particles 19 pierce the dielectric oxide film 11 formed on the valve metal element for an anode 10 to contact with the core 10C of the valve metal element for an anode 10. When a plurality of conductive particles 19 are used, it is not necessarily required that all of the conductive particles contact with the core 10C of the valve metal element for an anode 10. The electrical connection between the core portion 10C and the conductive particle which does not

contact with the core 10C is indirectly ensured, if this particle contacts with another particle which contacts with the core 10C. Further, the conductive particles 19 preferably pierce the portion which has concavities and convexities resulting ~~resulted~~ from the surface roughening treatment such as etching (that is, a roughened layer) so as to contact with a portion of the core which portion is not affected by the surface roughening treatment. The roughened layer is a region in the thickness direction which contains concavities and convexities formed by the surface roughening treatment. When the valve metal element for an anode is cut in a direction perpendicular to the thickness direction in sequence, a cut surface of the valve metal element for an anode becomes a plane where concavities and convexities are not observed, in due time. This plane corresponds to the border between the roughened layer and the portion which is not affected by the surface roughening treatment. Generally, the thickness of the roughened layer (that is, the distance in the thickness direction between the top of the highest convexity and the bottom of the deepest concavity) is in the range of 20 to 100 μm.

Please amend paragraph [0113] beginning at page 63, line 8, as follows:

[0113] The conductive particles 19 are preferably disposed so that they cover the entirety ~~entire~~ of both surfaces of the electrode lead part 10B, as shown in Fig. 7. Alternatively, the conductive particles 19 may be disposed so as to cover the entirety ~~entire~~ of one surface of the electrode lead part 10B. Alternatively, the conductive particles 19 may be disposed so as to cover a part of one surface or a part of both surfaces of the electrode lead part 10B.

Please amend paragraph [0118] beginning at page 66, line 4, as follows:

[0118] The conductive resin composition as described in connection with Embodiment 2 is preferably also prepared ~~also~~ as the conductive resin composition used for coating in this embodiment. Therefore, the detailed description is omitted.

Please amend paragraph [00119] beginning at page 66, line 8, as follows:

[0119] The conductive resin composition is applied to a surface of the electrode lead part of the valve metal element for an anode by an appropriate method. As an application method, a screen printing method, a dipping method or a method wherein a dispenser is used may be employed. Thereafter, the conductive resin composition is subjected to a heat treatment so that the uncured thermosetting resin is cured and the resin composition adheres to the surface of the electrode lead part of the valve metal element for an anode. The temperature and time for heat ~~head~~ treatment are not limited to particular ones, and the conditions as exemplified in connection with Embodiment 2 may be employed. When the electrolytic capacitor of this embodiment is produced, the treatments for repairing the defection in the dielectric oxide film and insulating the solid electrolyte layer are preferably performed in the same manner as in Embodiment 1 after the conductive resin composition resin has been applied.

Please amend paragraph [0127] beginning at page 70, line 10, as follows:

[0127] In the first circuit board 22, the electrically insulating layers are preferably formed of the same material as that of the electrically insulating substrate 25. In the case where the material for the electrically insulating layer is selected in this manner, the electrically insulating layers in the finally obtained circuit board with a built-in capacitor are made of the same material, which enables the internal stress due to lamination of different materials to be eliminated or reduced. Thereby, the connection reliability of the circuit board with a built-in capacitor is more improved.

Please amend paragraph [0128] beginning at page 70, line 20, as follows:

[0128] The electrically conductive filler which constitutes the electrically conductive adhesive 23 is not limited to a particular one as long as it is a stable particle of a low specific resistance and a low contact resistance. Specifically, powder made of a metal or an alloy of which the main component is Ag, Cu, Au, Ni, Pd or Pt may be used as the conductive filler. Particularly, Ag or Cu powder, or powder of an alloy containing Ag or Cu is preferably used. As the uncured thermosetting resin which constitutes the conductive adhesive 23, for example, an

epoxy resin, a phenol resin, a polyamide resin or a polyamide-imide resin may be used. These resins are preferably used because of high reliability. The thermosetting resin is preferably mixed in an amount of 30 to 150 parts by volume with the conductive filler of 100 parts by volume. The conductive adhesive 23 may further contain one or more additives selected from a curing agent, a curing catalyst, a surface active agent, a coupling agent and a lubricant.

Please amend paragraph [0135] beginning at page 74, line 21, as follows:

[0135] The via paste 26 is made by mixing electrically conductive powder and the uncured thermosetting resin. They are mixed by the same method as that employed for producing the conductive adhesive 23. As the conductive powder, powder made of a metal or an alloy of which the main component is Ag, Cu, Au, Ni, Pd or Pt, or an alloy thereof. Particularly, Ag or Cu powder, or powder of an alloy containing Ag or Cu is preferably used. As the uncured thermosetting resin, for example, an epoxy resin, a phenol resin, an isocyanate resin a polyamide resin or a polyamide-imide resin may be used. These resins are preferably used because of high reliability. The thermosetting resin is preferably mixed in an amount of 30 to 150 parts by volume with the conductive powder of 100 parts by volume. Further, a curing agent, a curing catalyst, a lubricant, a coupling agent, a surface active agent, a high boiling solvent and/or a reactive diluent may be further added to the via paste 26.

Please amend paragraph [0141] beginning at page 77, line 10, as follows:

[0141] Particularly, when the electrolytic capacitor as shown in Fig. 3 is used, it is preferable that the metal powder contained in the conductive resin composition 16 and the conductive filler contained in the conductive adhesive 23 are made of a ~~the~~ similar type of metal or alloy. In that case, the contact resistance between the conductive resin composition 16 and the conductive adhesive 23 can be suppressed, and the connection reliability is improved. Further, in the case where an electrically conductive resin composition covers a surface of the electrode lead part of the valve metal element for an anode in the electrolytic capacitor, as described in Embodiment 8, it is preferable that the metal powder contained in this resin composition and the

conductive filler contained in the conductive adhesive 23 are made of the similar type of metal or alloy. In any case, the metal powder and the conductive filler are preferably made of Cu, Ag, or an alloy containing Cu or Ag.

Please amend paragraph [0146] beginning at page 80, line 1, as follows:

[0146] Next, the electrically insulating substrate 25 and another copper foil 28a are superposed on the copper foil 28 to which the electrolytic capacitor is attached, followed by being heated and pressurized, as shown in Fig. 9(b). Thereby, the electrically insulating layer 29 which adheres to the copper foil 28 is formed and the electrolytic capacitor 24 is disposed within (that is, incorporated into) the electrically insulating layer 29, as shown in Fig. 9(c). Further, by this heating and pressurization, the via paste is cured to form the inner via 30. Next, the two copper foils 28 and 28a are patterned into a predetermined wiring pattern to give wiring layers 21 and 21a, whereby the circuit board with a built-in capacitor as shown in Fig. 9(d) is completed.

Please amend paragraph [0147] beginning at page 80, line 14, as follows:

[0147] In this embodiment, there is no circuit board (which corresponds to the circuit board 22 in Fig. 8) for supporting the electrolytic capacitor 24. For this reason, the thickness of the finally obtained circuit board with a built-in capacitor can come close to the thickness of the electrolytic capacitor 24 itself, resulting in a low-height circuit board with a built-in capacitor. Further, in the circuit board with a built-in capacitor, since the distance between the electrolytic capacitor 24 and the outermost wiring layer 21 is short, a lower resistance and ESL are achieved, which makes it possible to realize an excellent high-speed operation ~~responsibility~~.

Please amend paragraph [0149] beginning at page 81, line 11, as follows:

[0149] Further, in this embodiment, as shown in Fig. 9(b), the electrically insulating substrate 25 is disposed so that the via paste 26 contacts with the electrode lead part of the valve metal element for an anode of the electrolytic capacitor 24. As a result, the inner via 30 is positioned just above the through hole 15 of the electrolytic capacitor 24. By this configuration,

the inner via 30 can be brought into direct contact with the electrode lead part of the electrolytic capacitor 24 and with the conductive adhesive 23 via the through hole 15, which enables the wiring to be shortened and the resistance to be reduced. In this configuration, the conductive powder contained in the inner via 30 and the conductive filler contained in the conductive adhesive 23 is preferably made of <u>a</u> ~~the~~ similar type of metal or alloy.

Please amend paragraph [0150] beginning at page 82, line 1, as follows:

[0150] In the case where the electrolytic capacitor is any of the embodiments as shown in Figs. 3 to 7, the conductive component located within the through hole (that is, the metal powder contained in the conductive resin composition, or the conductive particle or the conductive fiber), the conductive powder contained in the inner via and the conductive filler contained in the conductive adhesive are preferably made of <u>a</u> ~~the~~ similar type of metal or alloy. In other words, in the connection region where the electrolytic capacitor and other component or element are connected, it is preferable that the materials of the conductive components are standardized or unified, whereby the resistance of the circuit board with a built-in capacitor is further reduced.

Please amend paragraph [0165] beginning at page 90, line 6, as follows:

[0165] The module with a built-in component makes it possible to dispose the semiconductor chip and the chip component near the low-height electrolytic capacitor that is connected with a low resistance, resulting in an electric circuit of a low resistance, a low stray capacitance and a low inductance. Therefore, this module with a built-in component is of a low loss, and excellent in high-frequency <u>operation</u> ~~responsibility~~. Further, many components can be mounted at a high density in this module, which enables the module to have a small area and many functions.

Please amend paragraph [0169] beginning at page 91, line 23, as follows:

[0169] In the switching power supply module of this embodiment, the switching element is placed near the electrolytic capacitor of a large capacitance and a low height which is

connected with a low resistance. For this reason, this switching power supply module can handle a large power density, and operates at a low loss. Further, in the switching power supply module of this embodiment, the switching element and the capacitor are connected with a wiring length shortened, resulting in formation of an electric circuit of a low inductance. Therefore, this switching power supply module is excellent in high-speed operation ~~responsibility~~, and stable with a low ripple voltage.

Please amend paragraph [0174] beginning at page 94, line 11, as follows:

[0174] As shown in Fig. 16, the microprocessor 53 is preferably disposed so that the electrolytic capacitor 24 is placed just below the microprocessor 53. Thereby, the area required for setting the module can be reduced. Further, this arrangement shortens the distance between the microprocessor and the electrolytic capacitor, resulting in a microprocessor module excellent in high-speed operation ~~responsibility~~.

Please amend paragraph [0175] beginning at page 94, line 19, as follows:

[0175] In the microprocessor module of this embodiment, the microprocessor and the chip capacitors as decoupling capacitors are disposed near the low-height electrolytic capacitor which is connected with a low resistance. For this reason, the microprocessor and the decoupling capacitors can be connected with a low resistance and a low inductance. Therefore, this microprocessor module is excellent in high-speed operation ~~responsibility~~ and stability of power input. Further, this embodiment enables a plurality of capacitors to be mounted at a high density, resulting in a microprocessor module having a small area and high operation stability.

Please amend paragraph [0177] beginning at page 95, line 13, as follows:

[0177] An aluminum foil with a thickness of 130 μm was prepared as a ~~an~~ valve metal element for an anode, and a surface of the foil was roughened by electrolytic etching. The surface roughening was conducted by applying an alternating current to the aluminum foil in an electrolytic solution containing hydrochloric acid mainly at a concentration of 10 wt % at a liquid

temperature of 35 °C. The roughened layer thus formed had a thickness of 40 μm. Next, the aluminum foil was cut so that a 3 mm square region was formed. The square region corresponded to a capacitor forming part.

Please amend paragraph [0185] beginning at page 98, line 23, as follows:

[0185] Next, through holes with a diameter of <u>0.2</u> [[2]] mm were formed in a predetermined positions of the sheet member by means of a punching machine. A via paste was made by kneading 87 wt % copper powder and 13 wt % epoxy resin (including a curing agent) by means of three rolls. This via paste was filled into the through holes formed in the sheet member by a printing method, so as to give an electrically insulating substrate.

Please amend paragraph [0189] beginning at page 100, line 20, as follows:

[0189] Each of these electrolytic <u>capacitors</u> ~~capacitor~~ was mounted on a glass-epoxy board in the same manner as in Example 1. The mean ESR at 100 kHz of these ten samples was 60 mΩ. This value is significantly lower than each of ESRs of the comparative samples shown in Fig. 12. Further, this value is lower than the mean value of the samples of Example 1 shown in Fig. 12. These results demonstrate that the through hole filled with the conductive resin composition is more advantageous for low-resistance connection.

Please amend paragraph [0195] beginning at page 103, line 3, as follows:

[0195] Each of these electrolytic <u>capacitors</u> ~~capacitor~~ was mounted on a glass-epoxy board in the same manner as in Example 1. The mean ESR at 100 kHz of ten samples was 70 mΩ. This value is significantly lower than each of ESRs of the comparative samples shown in Fig. 12.

Please amend paragraph [0198] beginning at page 104, line 2, as follows:

[0198] Each of these electrolytic <u>capacitors</u> ~~capacitor~~ was mounted on a glass-epoxy board in the same manner as in Example 1. The mean ESR at 100 kHz of ten samples was <u>50</u> ~~65~~

mΩ. This value is significantly lower than each of ESRs of the comparative samples shown in Fig. 12.